Video
FULL DETAILS AND TRANSCRIPT

Grow Your Own Brain

Topic: Encouraging Girls in Math and Science
Practice: Ability is Expandable

Highlights

- In this PBS special, Alan Alda explores how the brain develops.
- Recent research has shown that the brain continues to grow and develop new cells throughout a person's life—a revolutionary discovery.
- The brain's growth is impacted by the amount of stimuli the individual is exposed to—even simple physical exercise stimulates growth.
- Our brain controls our behavior, but our behavior can also affect the structure of our brain, which in turn is going to change how we behave.

About the Source

The Scientific American Frontiers program—which aired on PBS from 1990 until 2005—presented viewers with new discoveries and technologies in science and medicine. As the companion program to the Scientific American magazine, it featured explorations and developments from the cutting edge of medicine, mechanical and chemical engineering, computer design, environmental science and theoretical physics.

Full Transcript

ALAN ALDA: (Narration) Our next story begins in London, where of all the brains in the world, few have been changed more than the one behind the wheel of a London taxicab. No one can drive a traditional black cab in central London without first demonstrating "the Knowledge" -- a mental map of London's maze-like streets.

INSTRUCTOR: Can you take me from Winfield House, the American Ambassador's residence, to Old Bond Street?

CABBIE: Leave by gate, left down Park Road, bear right Baker Street, through Portman Square, left into Wigmore Street, right Welbeck Street.

ALAN ALDA: (Narration) Scientists recently scanned the brains of 16 volunteer London cabbies, and discovered that they all possessed a larger than normal hippocampus -- the area of the brain used for packaging memories before they're stored. Only months before, an even more astonishing discovery had been made about this same region of the brain.

FRED GAGE: So this is the imaging room.

ALAN ALDA: (Narration) Fred Gage here at the Salk Institute in California led a team that found brand new neurons in the hippocampus of Swedish cancer patients. Before they died of their disease, these patients had volunteered for a study that labeled any newborn cells in their bodies with a bright green dye. This is a slice of brain tissue from the hippocampus.

FRED GAGE: The green corresponds to the molecule that was injected into the blood of the patient 2 years before he died. Which means that the neuron was born when the patient in this case was 62 years old. And at some later point, it became a mature neuron in their brain.

ALAN ALDA: That was clear indication that there were cells dividing in this mature person?

FRED GAGE: Yes, yes.

ALAN ALDA: (Narration) This discovery has set the field of brain science on its head, overturning the long established dogma that once we are adults we only lose brain cells, never gain them.

FRED GAGE: There were not only cells dividing but cells that were becoming neurons in the adult brain.

ALAN ALDA: (Narration) Today research labs all over the world are scrambling to understand the implications of this discovery. The starting point for much of this work was a study of rats done at the University of Illinois. When rats were raised in an environment that's more interesting and challenging than the usual lab cage, their brain cells made many more connections. But there had never been any hint that they also made new neurons. until Fred Gage and his colleagues set up a similar study with mice. Not only did they find new neurons -- once again within the hippocampus -- but mice living a more interesting and active life had more new neurons than did mice sitting around being bored. The mice had running wheels as well as toys in the cage. To find out if simple exercise had anything to do with growing new brain cells, the Salk team gave some mice just a running wheel.

HENRIETTE VAN PRAAG: To our surprise, we found that mice housed just with the running wheel had the same number of newborn brain cells as the enriched environment, suggested that just physical activity, or exercise alone, can generate new brain cells.

ALAN ALDA: (Narration) Having new neurons sounds good. But do they do any good?

HENRIETTE VAN PRAAG: This is his very first time in the pool, he's never been in the pool ever before in his life.

ALAN ALDA: (Narration) Henriette tested her mice for their ability to find a platform hidden just beneath the surface of the milky water.

ALAN ALDA: He doesn't even know there's a platform, huh?

HENRIETTE VAN PRAAG: He doesn't know. He knows nothing.

ALAN ALDA: Has he found it?

HENRIETTE VAN PRAAG: He's found it. But basically he's been lucky. It usually takes two or three days for the mouse to learn this task and seven days of training for it to learn it really well -- for me to put him in the pool and he'll swim to it in one straight line in two or three seconds.

ALAN ALDA: (Narration) Henriette compared the time it took for both the exercised mice and mice housed in standard cages to find the platform.

ALAN ALDA: Do they tend to go around the outside and then start to look for other paths? Woom, he found it.

HENRIETTE VAN PRAAG: It actually turned out very well for the mice on the running wheel because they managed to escape from the water faster, in a shorter amount of time than mice housed in standard conditions. So this suggests that these mice have learned better and that they are smarter.

ALAN ALDA: (Narration) So running mice not only grow more new neurons. They also seem to be benefiting from all that extra brain.

ALAN ALDA: Have you started running?

HENRIETTE VAN PRAAG: I've started and stopped running.

ALAN ALDA: But we all do that! Did you start because of this? And why did you stop?

HENRIETTE VAN PRAAG: I started because of my experimental results and because of looking at my slides with this dramatic increase in new brain cells. But you have to be pretty disciplined to keep it up and keep

running every day.

ALAN ALDA: So are you maybe hoping that further experiments will show that you don't actually have to run? Maybe just rocking in the chair would be enough to do it, you know.

HENRIETTE VAN PRAAG: Well, what worried me was that these mice were running twelve hours every night. I wondered how we could even run enough to compare with that. So we did one experiment where we brought down the time of running to four hours every night for five days and we already found a 30% increase in cell division just after the short period of time. So I'm hoping we can bring it down.

ALAN ALDA: To something we can handle. Good. Call me when you find out, OK?

ALAN ALDA: (Narration) The task now is to find out just how running or an enriched environment creates new neurons. Growing cells in a dish outside the brain is one way the Salk researchers are exploring this question. These are brain cells actually dividing under the microscope. The hope is to discover the chemical signals involved, and then find ways to use these chemicals directly to grow new neurons -- perhaps even in the brains of people such as Parkinson's or Alzheimer's patients who have lost neurons to their disease. In the meantime, I'll never think of my own brain in quite the same way again.

ALAN ALDA: There must be in my brain right now a lot of stuff going on, birth and migration of cells. Am I right about that? Should I have a new picture of my brain?

FRED GAGE: I think almost more remarkable than just the fact -- which is remarkable enough -- that there's all this movement and plasticity, that that movement and plasticity and adaptation that's occurring all the time in the brain is regulated by the behavior that you emit as an individual. Our brain controls our behavior, but our behavior can also affect the structure of our brain, which in turn is going to change how we behave.

ALAN ALDA: (Narration) Which brings us back to those London cabbies again. Perhaps the reason for their enlarged hippocampus is that they are adding neurons with all that enrichment they're getting navigating London streets. Now just imagine how much extra brain a cabbie might grow if he ran twelve hours a night!